

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Chemical Engineering (05)
SUBJECT NAME: PROCESS EQUIPMENT DESIGN-II
SUBJECT CODE: 2170502
B.E. 7th SEMESTER

Type of course: Chemical Engineering

Prerequisite: The student should have basic understanding of Unit Operations of Chemical Engineering and mechanical properties associated with the material.

Rationale:

Equipment design involves modifications and additions to existing plants or creating design layouts of plant / equipments. With rapid rate of increase in the advancement of knowledge, it is important that the students should know the relevant application for equipment design. It has been observed conclusively that practice in using the reference literature and software has helped the students to secure jobs and also to perform better in profession.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction : Concept of internal & external design pressure, design stress & design temperature, Different types of equipments, Static & rotary equipments, Different types of static equipments, Various mechanical properties of material, Different methods of fabrication, Different types of welding joints, Joint efficiency, Radiography.	04	8
2	Mechanical design of Pressure vessel: Introduction of ASME Code sec-VIII, DIV-I & IS-2825, Classification of pressure vessel as per IS-2825, Mechanical design of Shell: shell subjected to internal pressure, Graphical & analytical method for Shell subjected to external pressure, design of shell for external pressure with & without stiffening ring, Different types of head, their selection criteria, Mechanical design of heads: Heads subjected to internal pressure, Graphical & analytical method for heads subjected to external pressure, Different types of Nozzles, their selection criteria, Design of nozzle pipe, Design of reinforcement pad by area for area method, Different types of flanges, Different types of standard flanges, their important features & selection criteria, Different types of flange facings & their	20	37

	selection criteria, Different types of gaskets, their selection criteria, Design of ring flange.		
3	Mechanical design of Reaction Vessel: Mechanical design of shell, head, Jacket, coil, agitator, nozzle, body flange, etc., Different types of agitators & their selection criteria, Different types of agitator shaft sealing system & their selection criteria, Different types of power transmission system, Determination of power required for agitation, shaft diameter, blade thickness, etc., Different types of jackets & their selection criteria, Selection between coil & jacket	06	11
4	Mechanical design of Storage Tank: Classification of storage tank as per IS-803, Capacity of storage tank, its diameter & height, Design of shell and bottom plate for storage tank, Design of Self supported conical roof, Design of structured supported conical roof as per API 620, Selection of column, girders and rafters, Roof curb angel, Floating roof.	05	9
5	Mechanical design of Shell & Tube Heat Exchangers: Mechanical design of Shell, tube, tube sheet, head, channel shell, , etc. of shell & tube heat exchanger	05	9
6	Mechanical design of Vertical tall tower (Distillation Column): Mechanical design of shell, head, tray support, nozzle, body flange, for Vertical tall tower, Determination of shell thicknesses at various heights for tray tower & packed tower in case of internal & external pressure, Different types of tray supports & their selection criteria, design of horizontal structural member with periphery ring type packing support	08	15
7	Supports : Different types of supports, Mechanical design of bracket support, skirt, support & saddle support	06	11

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	21	21	7	14	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Process Equipment Design - Vessel Design - L.E. Brownell & E.H.Young, First Edition.
2. Illustrated Process Equipment Design by S B Thakore, Second edition,.
3. Process Equipment Design - M.V.Joshi & V V Mahajani, Third edition.
4. Process Equipment Design (Mechanical Aspects) By B.C.Bhattacharya.

Course Outcome:

After learning the course the students should be able to:

1. Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
2. Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
3. Create understanding of equipment design with mechanical concept.
4. Review the importance of design concepts in process industry.

List of Tutorials:

- Prediction of Physical properties
- Estimation of various design parameters for various equipments.
- Solution of various problem used in the designing of equipments.

List of Open Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL lecture series.
- Students can refer to the CDs available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.
- MIT Open course lecture on Equipment design.
- Literature available for Process design of equipment in plant / industry.

ACTIVE LEARNING ASSIGNMENTS:

The tutorials will be given to students which will cover entire content of the subject. The students will be required to solve all problems given in the tutorials. Some of the problems they have to solve using programming language or software. The list is given below:

- Excel Spreadsheets
- Polymath
- Matlab/Scilab, etc.